FIG.1

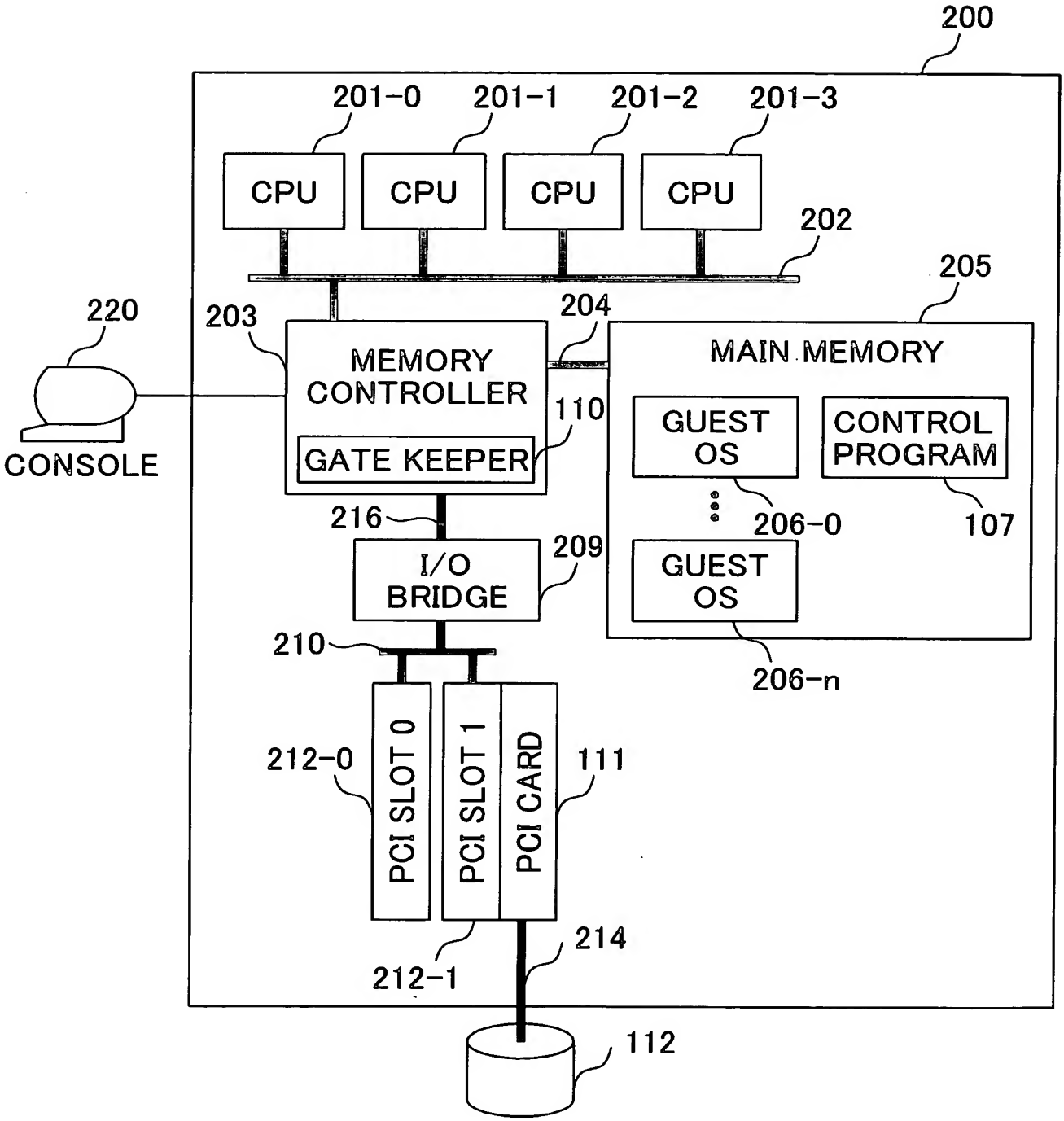

200
201-0
201-1
201-2
201-3
CPU
CPU
CPU
CPU
202
205
220
203
204
MEMORY CONTROLLER
MAIN MEMORY
110
GUEST OS
CONTROL PROGRAM
CONSOLE
GATE KEEPER
206-0
107
216
I/O BRIDGE
209
GUEST OS
210
206-n
212-0
PCI SLOT 0
PCI SLOT 1
PCI CARD
111
214
212-1
112

FIG.2

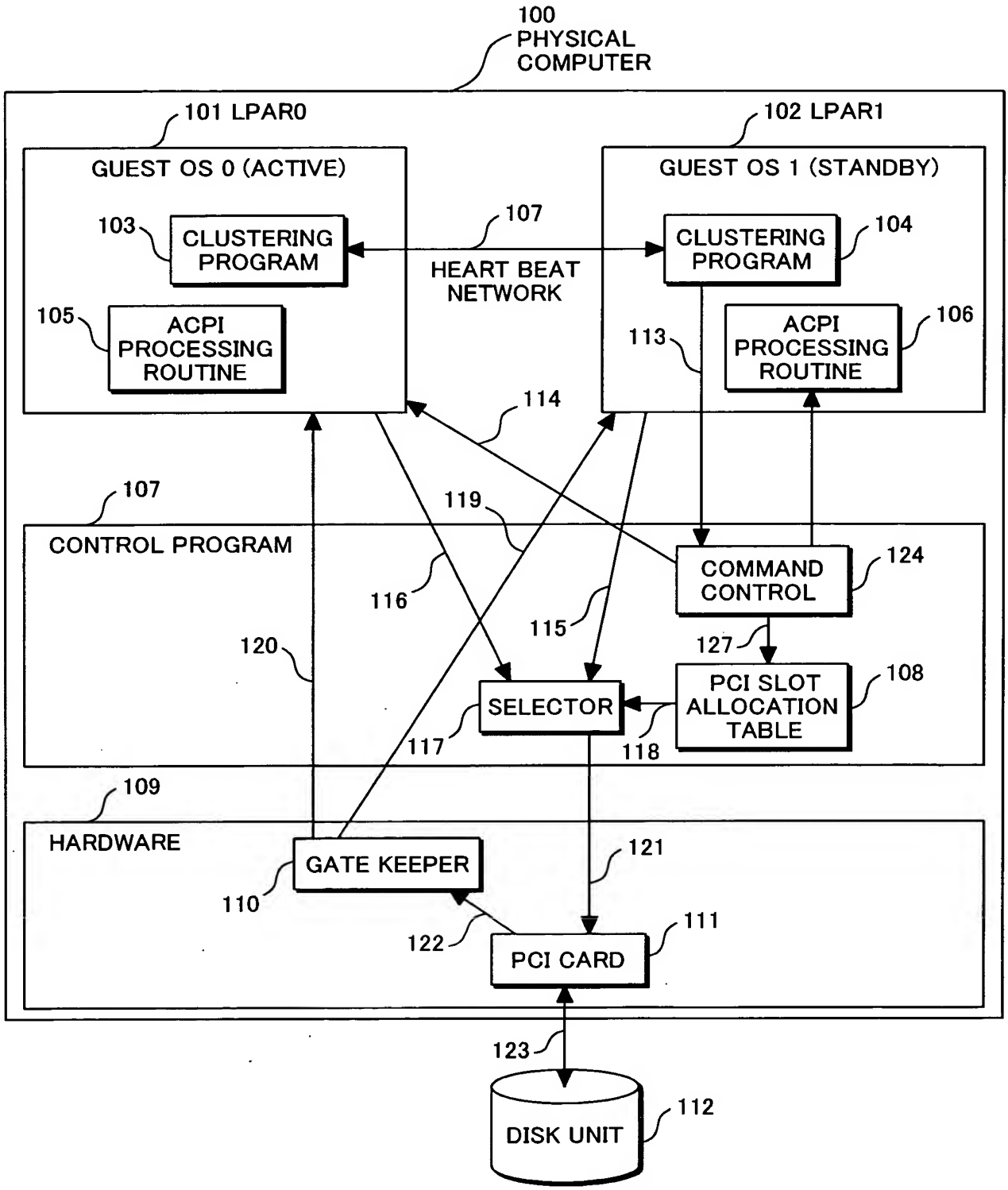

100
PHYSICAL
COMPUTER
101 LPAR0
GUEST OS 0 (ACTIVE)
102 LPAR1
GUEST OS 1 (STANDBY)
103
CLUSTERING
PROGRAM
107
HEART BEAT
NETWORK
CLUSTERING
PROGRAM
104
105
ACPI
PROCESSING
ROUTINE
113
ACPI
PROCESSING
ROUTINE
106
114
107
CONTROL PROGRAM
119
COMMAND
CONTROL
124
116
115
120
127
SELECTOR
PCI SLOT
ALLOCATION
TABLE
108
117
118
109
HARDWARE
GATE KEEPER
121
110
122
PCI CARD
111
123
DISK UNIT
112

FIG.3

	COMMAND NAME	VIRTUAL MACHINE NUMBER
(a)	deact	LPAR=0
(b)	act	LPAR=0
(c)	add_pci	LPAR=0
(d)	rem_pci	LPAR=0

FIG.4

PCI slot #	CONNECTED TO	ENABLE FLAG
0	LPAR0	1
1	LPAR0	1

400

PCI slot #	CONNECTED TO	ENABLE FLAG
0	LPAR0	0
1	LPAR0	0

401

PCI slot #	CONNECTED TO	ENABLE FLAG
0	LPAR1	1
1	LPAR1	1

402

FIG.5

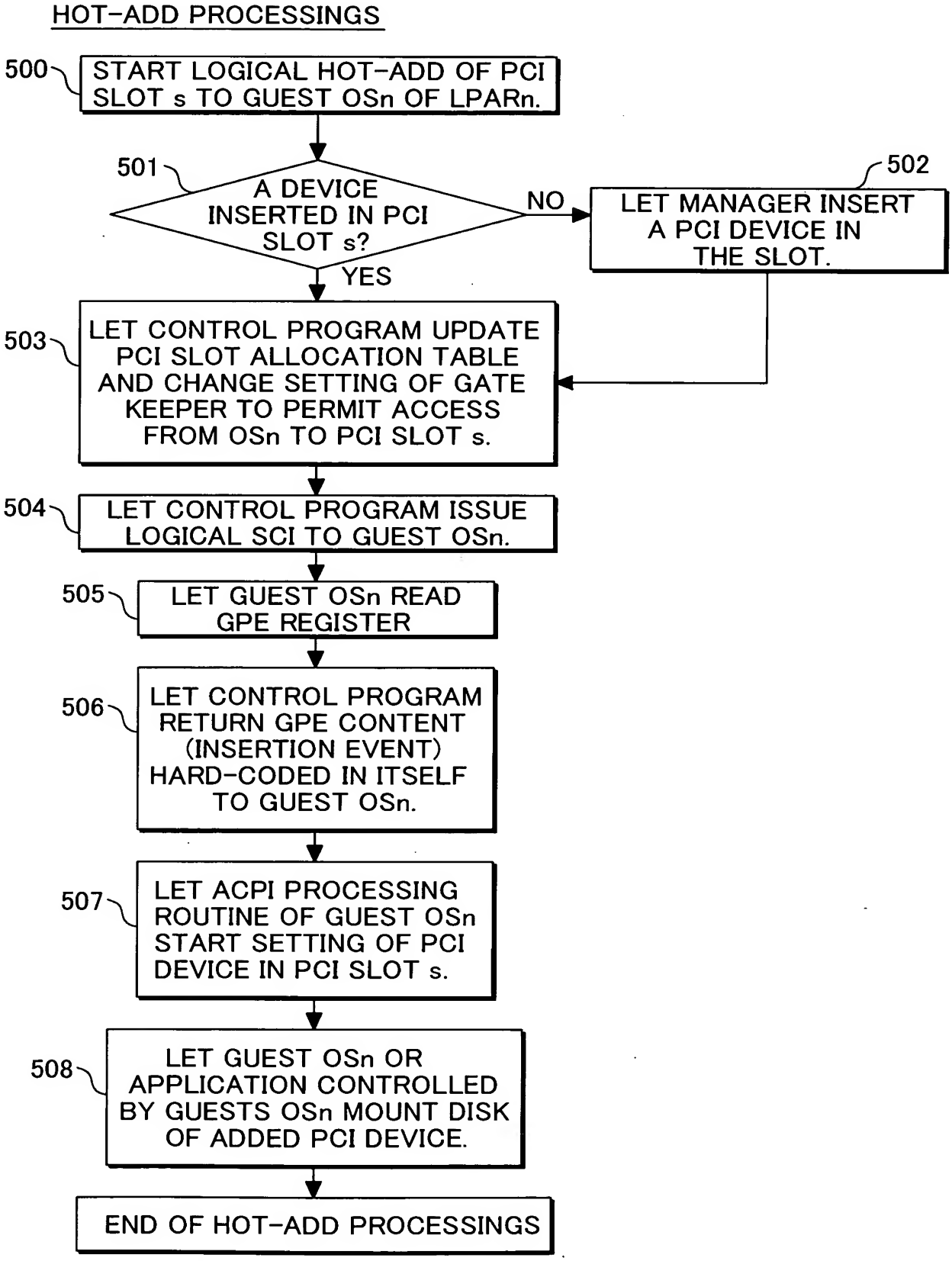

HOT-ADD PROCESSINGS
500
START LOGICAL HOT-ADD OF PCI SLOT s TO GUEST OSn OF LPARn.
501
A DEVICE INSERTED IN PCI SLOT s?
NO
502
LET MANAGER INSERT A PCI DEVICE IN THE SLOT.
YES
503
LET CONTROL PROGRAM UPDATE PCI SLOT ALLOCATION TABLE AND CHANGE SETTING OF GATE KEEPER TO PERMIT ACCESS FROM OSn TO PCI SLOT s.
504
LET CONTROL PROGRAM ISSUE LOGICAL SCI TO GUEST OSn.
505
LET GUEST OSn READ GPE REGISTER
506
LET CONTROL PROGRAM RETURN GPE CONTENT (INSERTION EVENT) HARD-CODED IN ITSELF TO GUEST OSn.
507
LET ACPI PROCESSING ROUTINE OF GUEST OSn START SETTING OF PCI DEVICE IN PCI SLOT s.
508
LET GUEST OSn OR APPLICATION CONTROLLED BY GUESTS OSn MOUNT DISK OF ADDED PCI DEVICE.
END OF HOT-ADD PROCESSINGS

FIG.6

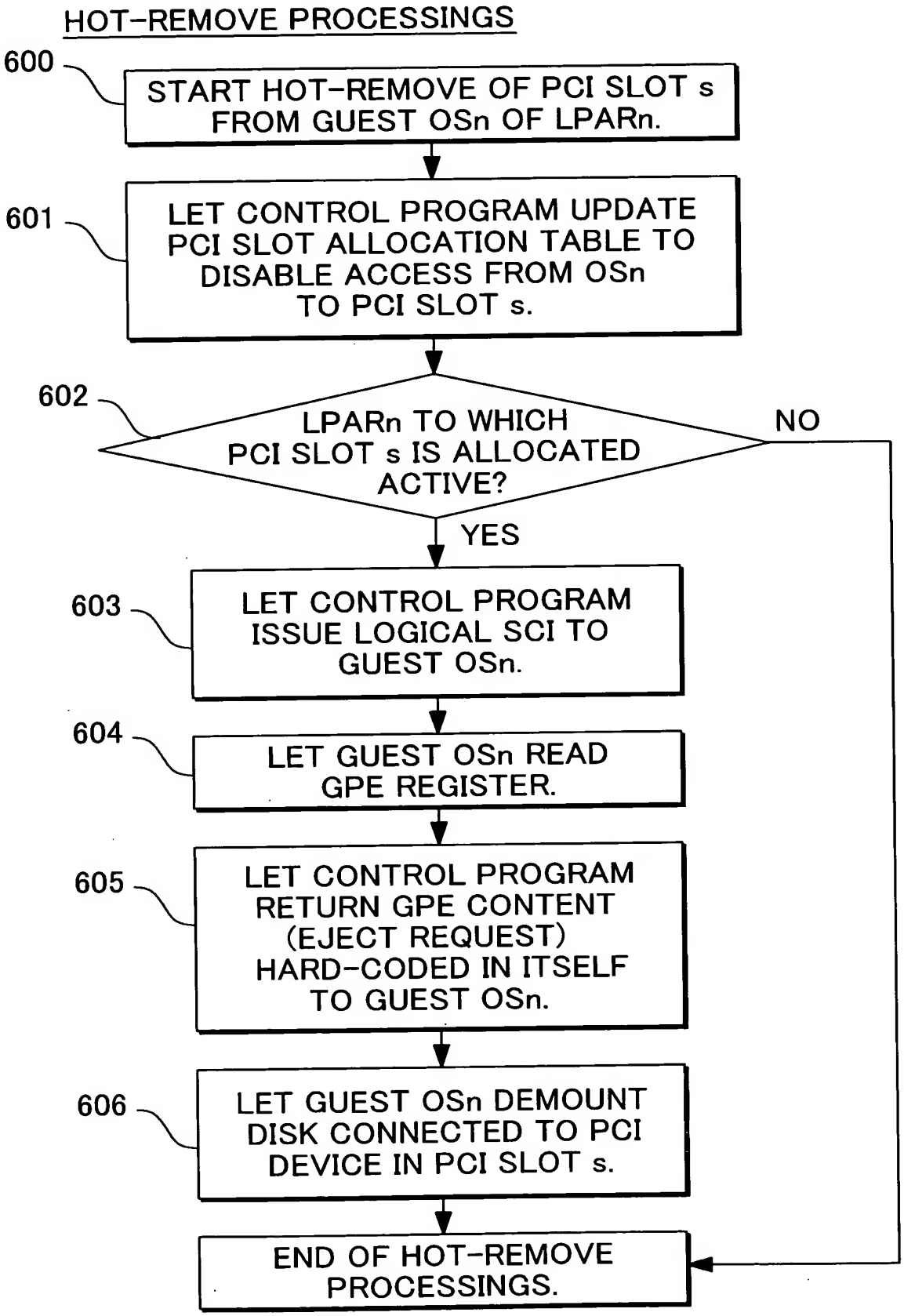

HOT-REMOVE PROCESSINGS
600
START HOT-REMOVE OF PCI SLOT s FROM GUEST OSn OF LPARn.
601
LET CONTROL PROGRAM UPDATE PCI SLOT ALLOCATION TABLE TO DISABLE ACCESS FROM OSn TO PCI SLOT s.
602
LPARn TO WHICH PCI SLOT s IS ALLOCATED ACTIVE?
NO
YES
603
LET CONTROL PROGRAM ISSUE LOGICAL SCI TO GUEST OSn.
604
LET GUEST OSn READ GPE REGISTER.
605
LET CONTROL PROGRAM RETURN GPE CONTENT (EJECT REQUEST) HARD-CODED IN ITSELF TO GUEST OSn.
606
LET GUEST OSn DEMOUNT DISK CONNECTED TO PCI DEVICE IN PCI SLOT s.
END OF HOT-REMOVE PROCESSINGS.

FIG. 7

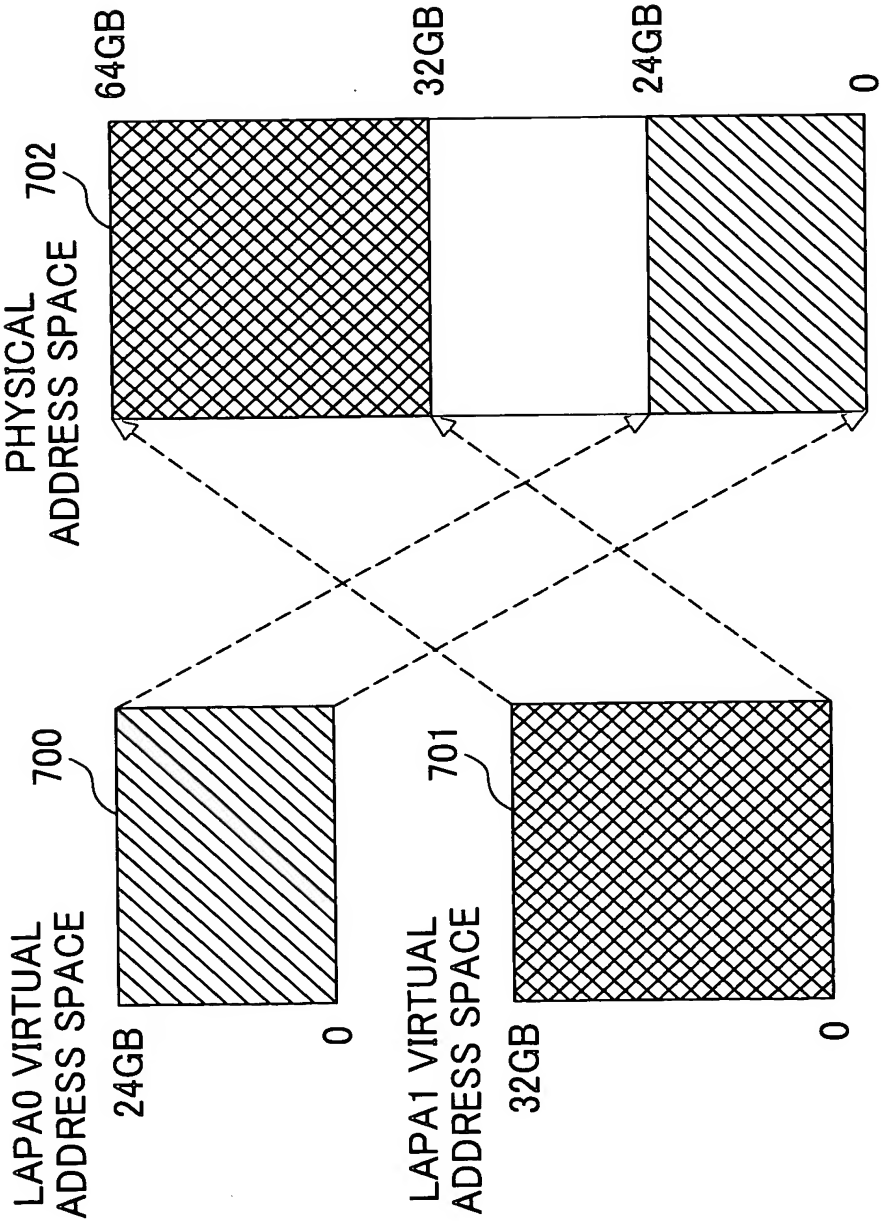

64GB
32GB
24GB
0
PHYSICAL ADDRESS SPACE
702
LAPA0 VIRTUAL ADDRESS SPACE
700
24GB
0
LAPA1 VIRTUAL ADDRESS SPACE
701
32GB
0

FIG.8A

PCI bus #	BASE	SIZE	OFFSET
0	0	24GB	+0

FIG.8B

PCI bus #	BASE	SIZE	OFFSET
0	0	32GB	+32GB

FIG.9

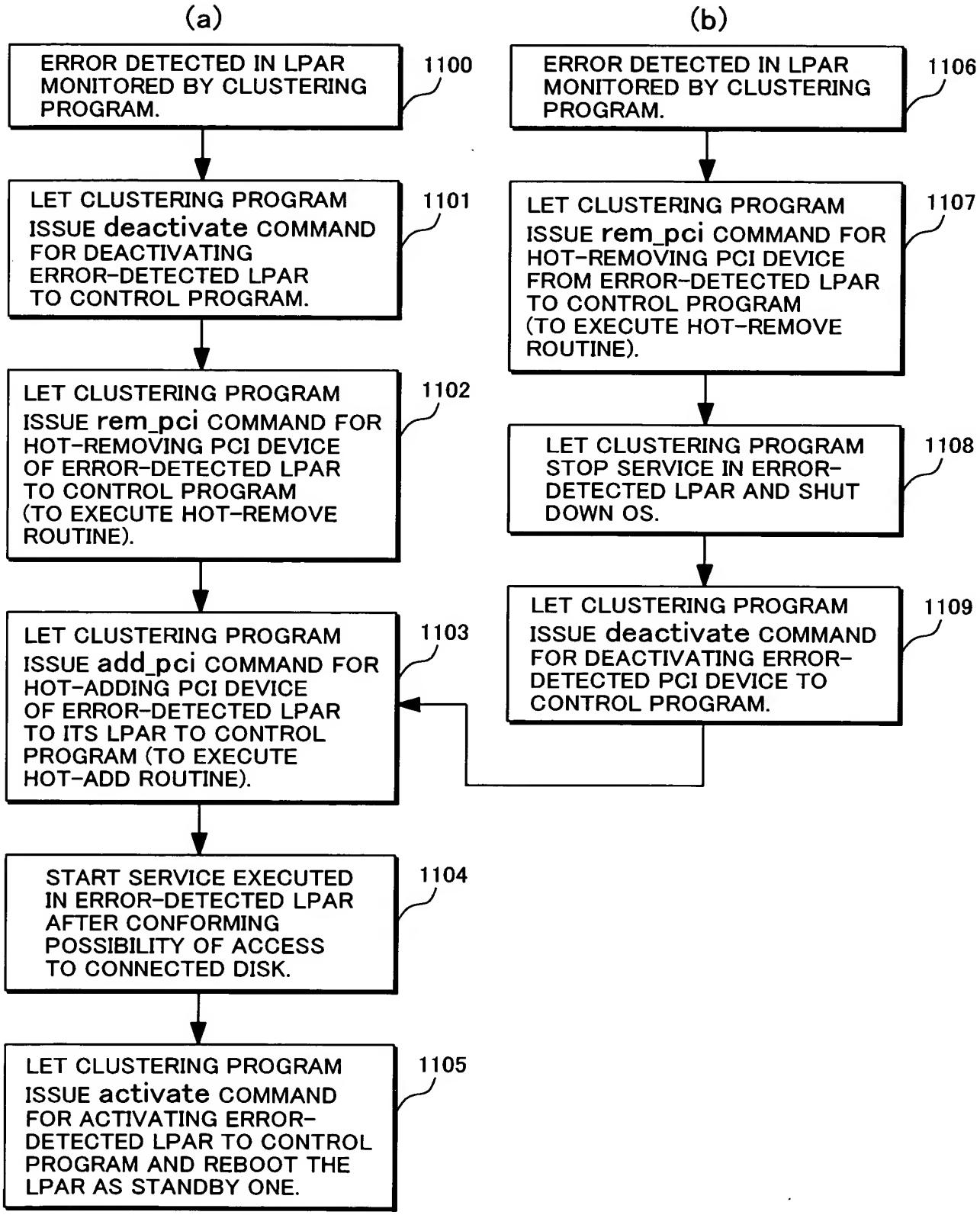

(a)
ERROR DETECTED IN LPAR MONITORED BY CLUSTERING PROGRAM.
1100
LET CLUSTERING PROGRAM ISSUE deactivate COMMAND FOR DEACTIVATING ERROR-DETECTED LPAR TO CONTROL PROGRAM.
1101
LET CLUSTERING PROGRAM ISSUE rem_pci COMMAND FOR HOT-REMOVING PCI DEVICE OF ERROR-DETECTED LPAR TO CONTROL PROGRAM (TO EXECUTE HOT-REMOVE ROUTINE).
1102
LET CLUSTERING PROGRAM ISSUE add_pci COMMAND FOR HOT-ADDING PCI DEVICE OF ERROR-DETECTED LPAR TO ITS LPAR TO CONTROL PROGRAM (TO EXECUTE HOT-ADD ROUTINE).
1103
START SERVICE EXECUTED IN ERROR-DETECTED LPAR AFTER CONFORMING POSSIBILITY OF ACCESS TO CONNECTED DISK.
1104
LET CLUSTERING PROGRAM ISSUE activate COMMAND FOR ACTIVATING ERROR-DETECTED LPAR TO CONTROL PROGRAM AND REBOOT THE LPAR AS STANDBY ONE.
1105
(b)
ERROR DETECTED IN LPAR MONITORED BY CLUSTERING PROGRAM.
1106
LET CLUSTERING PROGRAM ISSUE rem_pci COMMAND FOR HOT-REMOVING PCI DEVICE FROM ERROR-DETECTED LPAR TO CONTROL PROGRAM (TO EXECUTE HOT-REMOVE ROUTINE).
1107
LET CLUSTERING PROGRAM STOP SERVICE IN ERROR-DETECTED LPAR AND SHUT DOWN OS.
1108
LET CLUSTERING PROGRAM ISSUE deactivate COMMAND FOR DEACTIVATING ERROR-DETECTED PCI DEVICE TO CONTROL PROGRAM.
1109

FIG.10

(a)

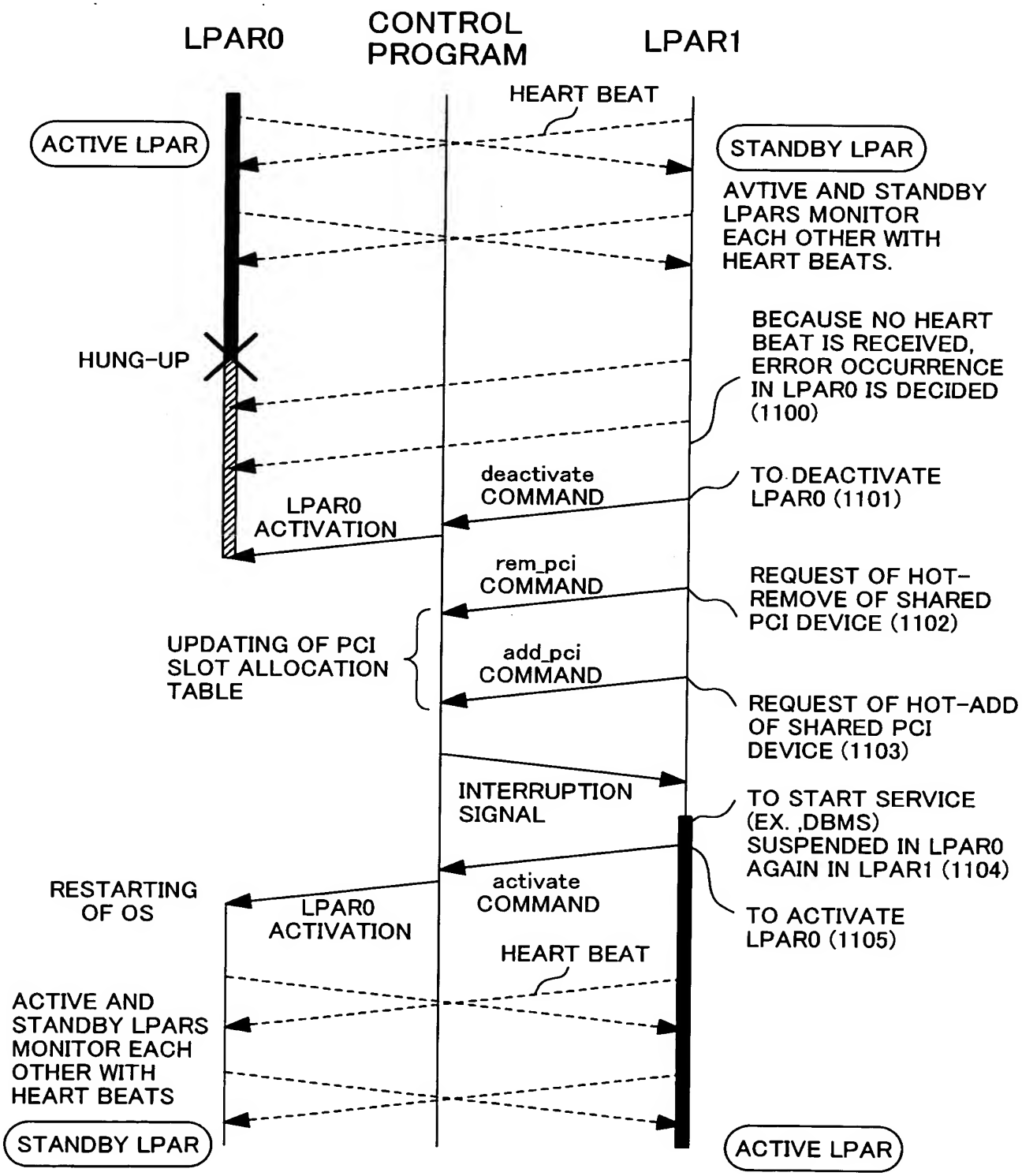

LPAR0
CONTROL PROGRAM
LPAR1
HEART BEAT
ACTIVE LPAR
STANDBY LPAR
AVTIVE AND STANDBY LPARS MONITOR EACH OTHER WITH HEART BEATS.
HUNG-UP
BECAUSE NO HEART BEAT IS RECEIVED, ERROR OCCURRENCE IN LPAR0 IS DECIDED (1100)
deactivate COMMAND
TO DEACTIVATE LPAR0 (1101)
LPAR0 ACTIVATION
rem_pci COMMAND
REQUEST OF HOT-REMOVE OF SHARED PCI DEVICE (1102)
UPDATING OF PCI SLOT ALLOCATION TABLE
add_pci COMMAND
REQUEST OF HOT-ADD OF SHARED PCI DEVICE (1103)
INTERRUPTION SIGNAL
TO START SERVICE (EX. ,DBMS) SUSPENDED IN LPAR0 AGAIN IN LPAR1 (1104)
RESTARTING OF OS
LPAR0 ACTIVATION
activate COMMAND
TO ACTIVATE LPAR0 (1105)
HEART BEAT
ACTIVE AND STANDBY LPARS MONITOR EACH OTHER WITH HEART BEATS
STANDBY LPAR
ACTIVE LPAR

FIG.11

(b)

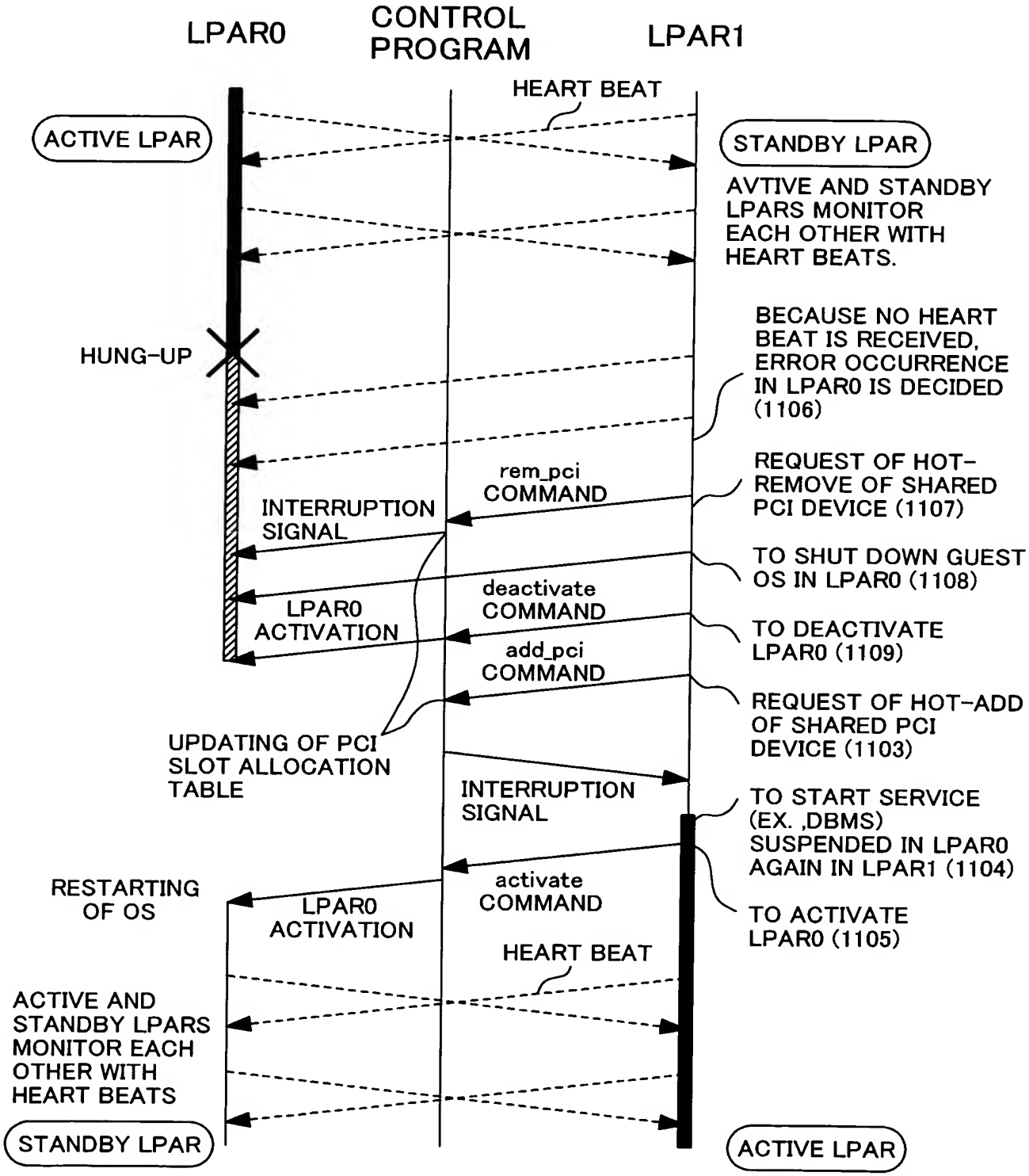

LPAR0
CONTROL PROGRAM
LPAR1
HEART BEAT
ACTIVE LPAR
STANDBY LPAR
AVTIVE AND STANDBY LPARS MONITOR EACH OTHER WITH HEART BEATS.
HUNG-UP
BECAUSE NO HEART BEAT IS RECEIVED, ERROR OCCURRENCE IN LPAR0 IS DECIDED (1106)
rem_pci COMMAND
REQUEST OF HOT-REMOVE OF SHARED PCI DEVICE (1107)
INTERRUPTION SIGNAL
TO SHUT DOWN GUEST OS IN LPAR0 (1108)
deactivate COMMAND
LPAR0 ACTIVATION
TO DEACTIVATE LPAR0 (1109)
add_pci COMMAND
REQUEST OF HOT-ADD OF SHARED PCI DEVICE (1103)
UPDATING OF PCI SLOT ALLOCATION TABLE
INTERRUPTION SIGNAL
TO START SERVICE (EX. ,DBMS) SUSPENDED IN LPAR0 AGAIN IN LPAR1 (1104)
RESTARTING OF OS
LPAR0 ACTIVATION
activate COMMAND
TO ACTIVATE LPAR0 (1105)
HEART BEAT
ACTIVE AND STANDBY LPARS MONITOR EACH OTHER WITH HEART BEATS
STANDBY LPAR
ACTIVE LPAR

FIG.12

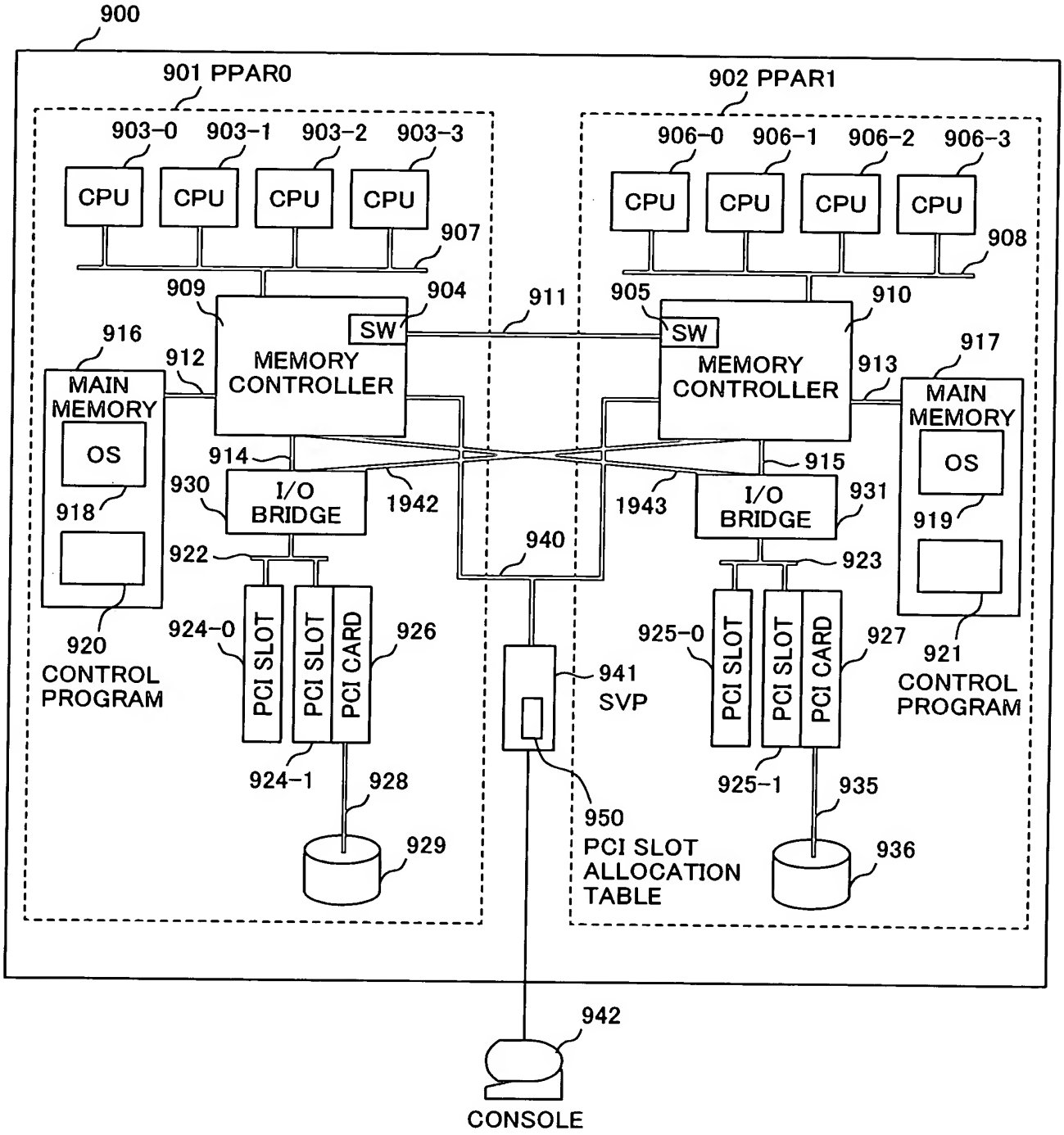

900
901 PPAR0
902 PPAR1
903-0
903-1
903-2
903-3
906-0
906-1
906-2
906-3
CPU
907
908
909
904
911
905
910
SW
MEMORY CONTROLLER
916
912
913
917
MAIN MEMORY
OS
914
915
930
I/O BRIDGE
1942
1943
931
918
919
940
922
923
924-0
PCI SLOT
PCI CARD
926
925-0
927
920
CONTROL PROGRAM
941
SVP
921
924-1
928
925-1
935
929
950
PCI SLOT ALLOCATION TABLE
936
942
CONSOLE

FIG.13

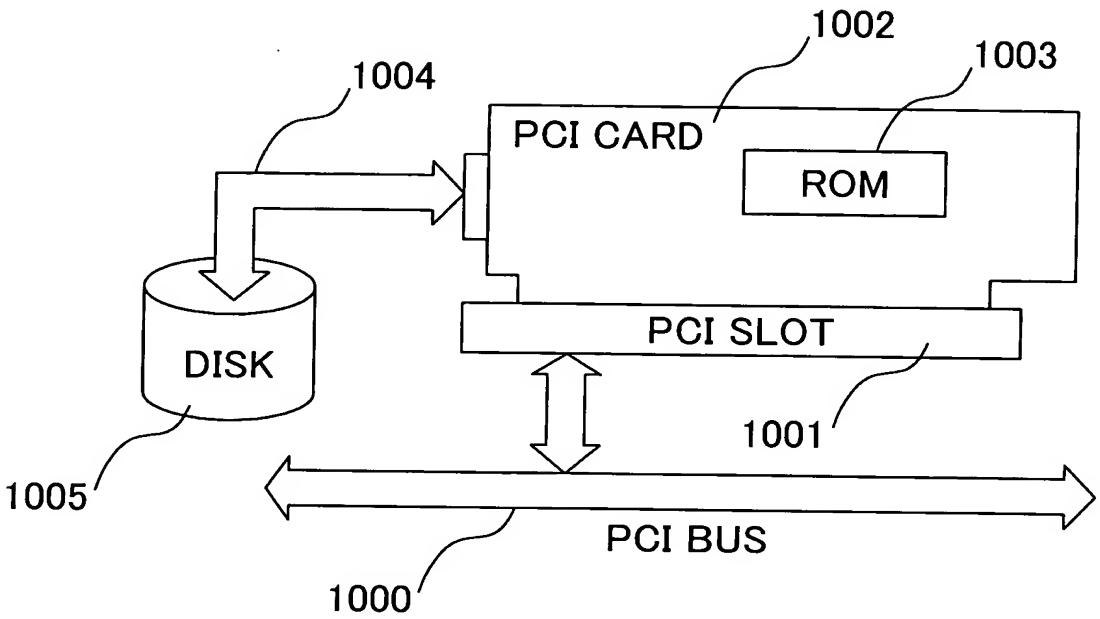

1002
1003
1004
PCI CARD
ROM
DISK
PCI SLOT
1001
1005
PCI BUS
1000

FIG.14

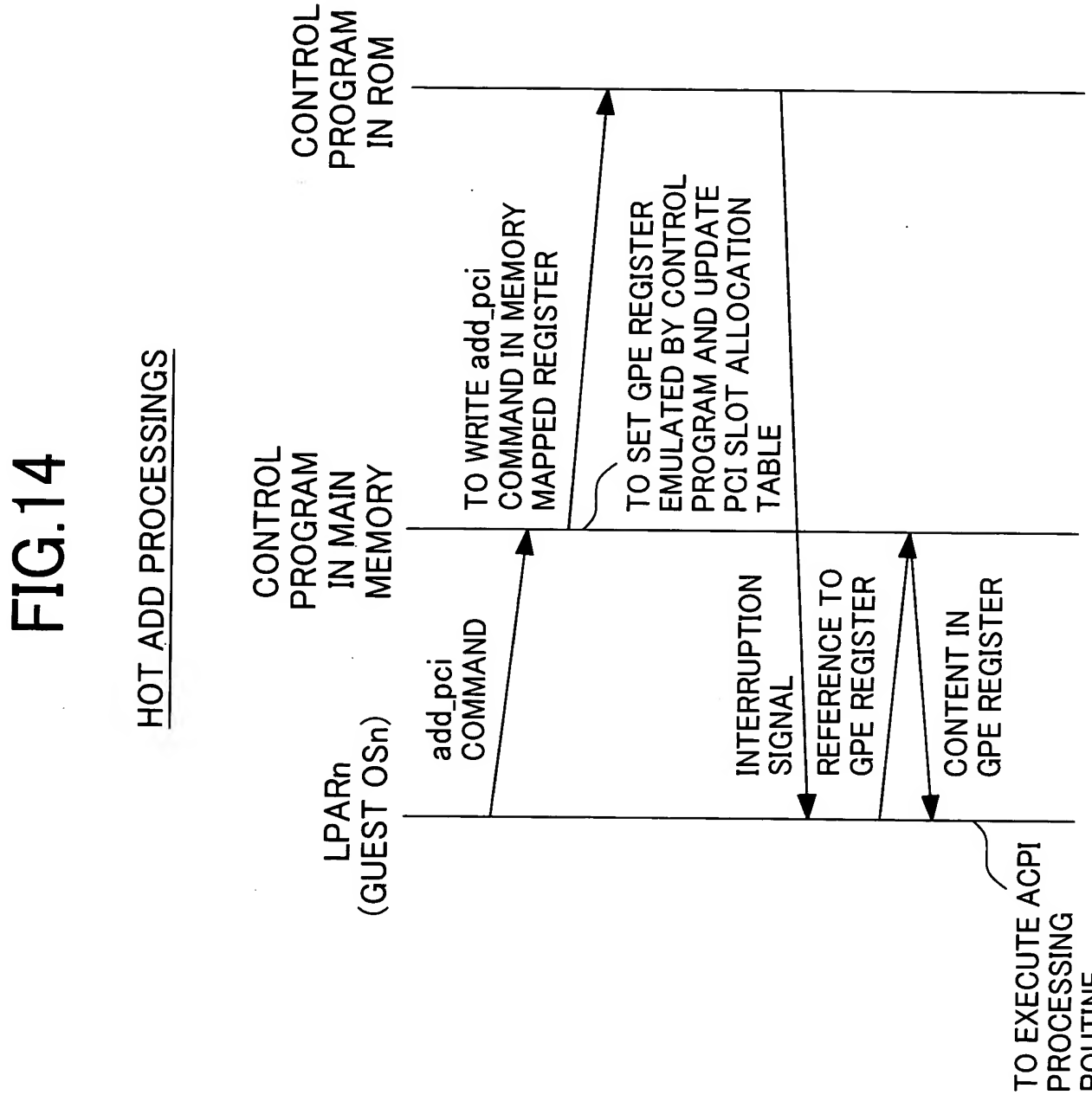

HOT ADD PROCESSINGS
LPARn (GUEST OSn)
CONTROL PROGRAM IN MAIN MEMORY
CONTROL PROGRAM IN ROM
add_pci COMMAND
TO WRITE add_pci COMMAND IN MEMORY MAPPED REGISTER
TO SET GPE REGISTER EMULATED BY CONTROL PROGRAM AND UPDATE PCI SLOT ALLOCATION TABLE
INTERRUPTION SIGNAL
REFERENCE TO GPE REGISTER
CONTENT IN GPE REGISTER
TO EXECUTE ACPI PROCESSING ROUTINE

FIG.15

HOT REMOVE PROCESSINGS

(TO HOT-REMOVE A PCI DEVICE ALLOCATED TO LPARn FROM LPARm)

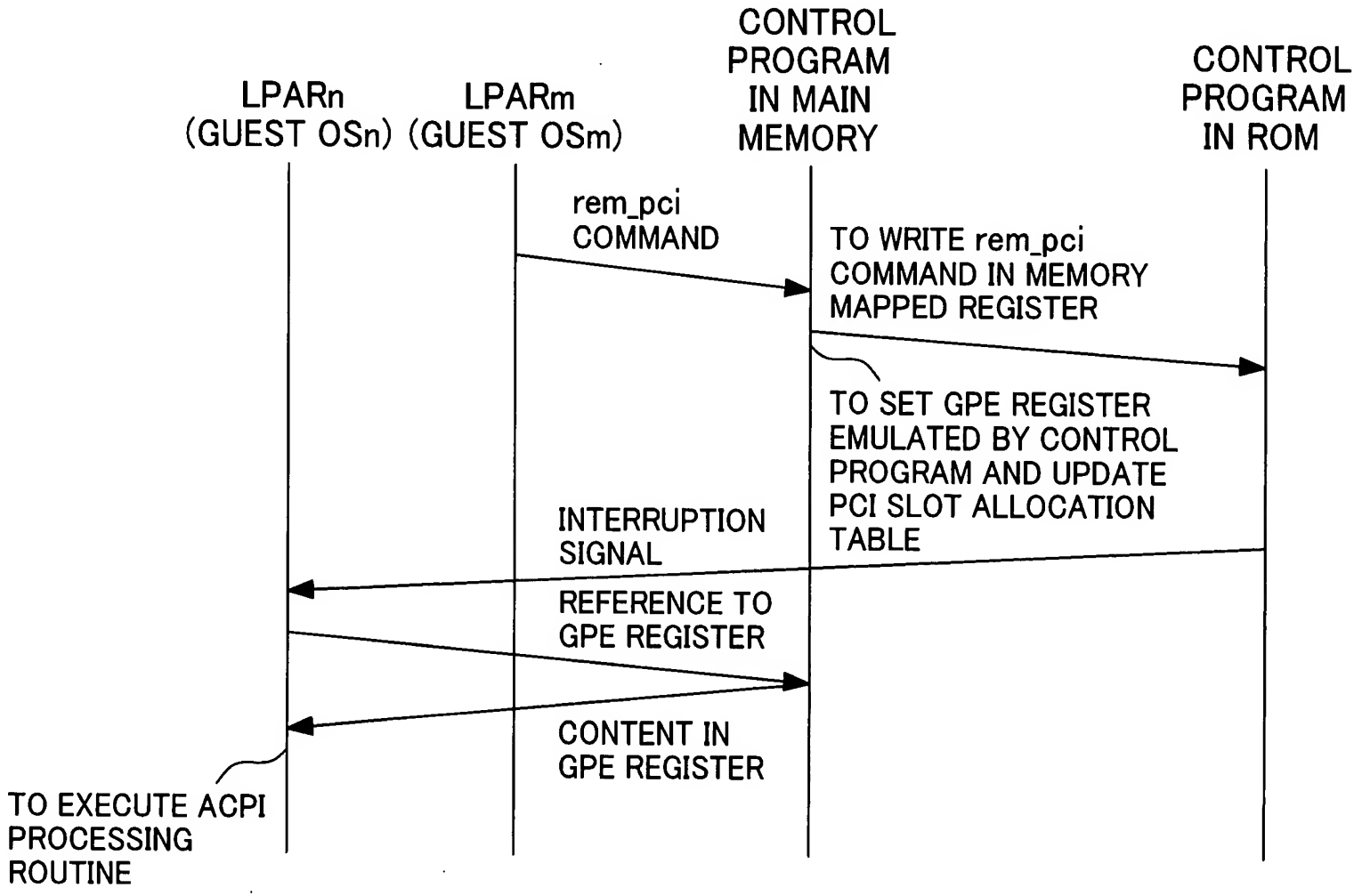


FIG.16

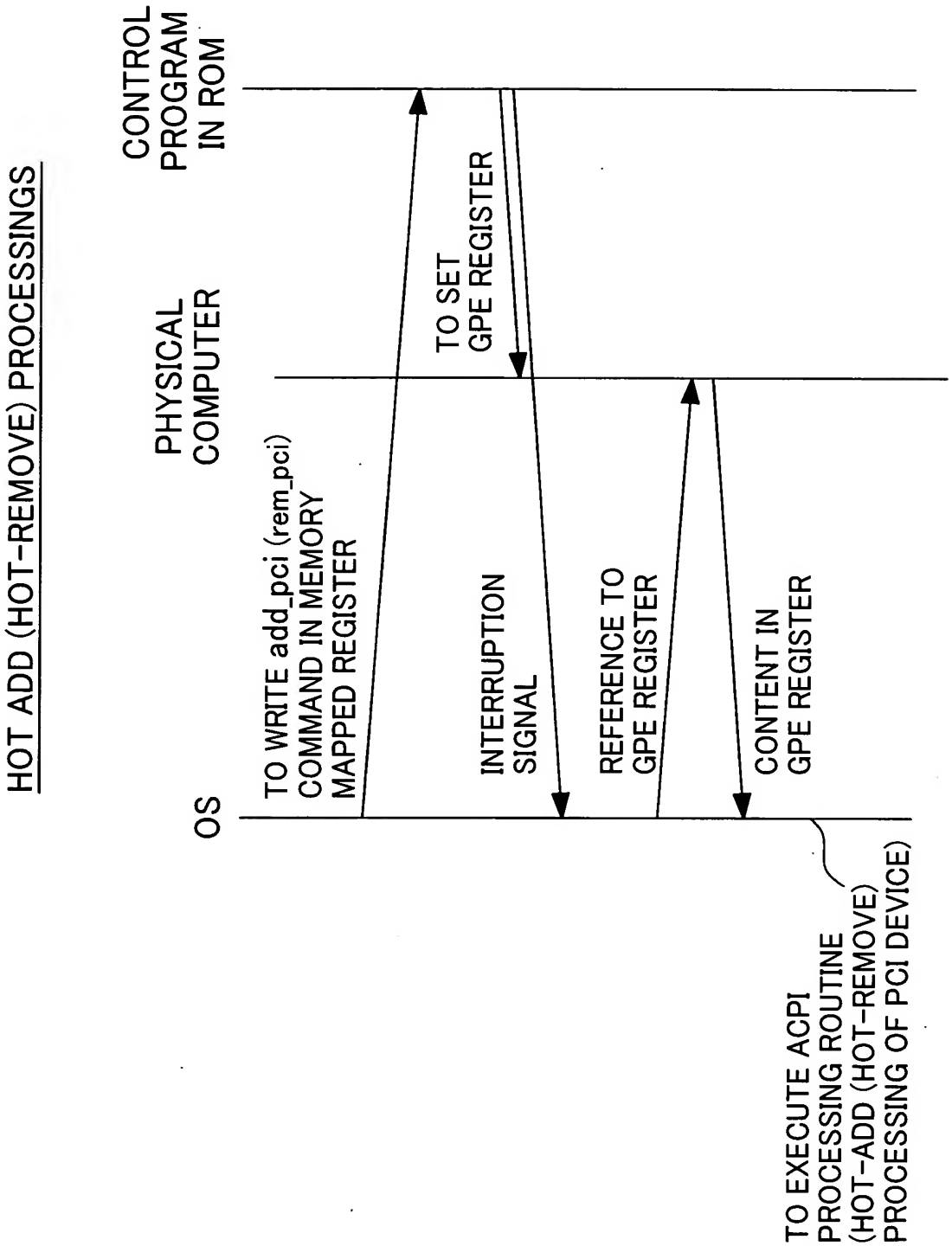
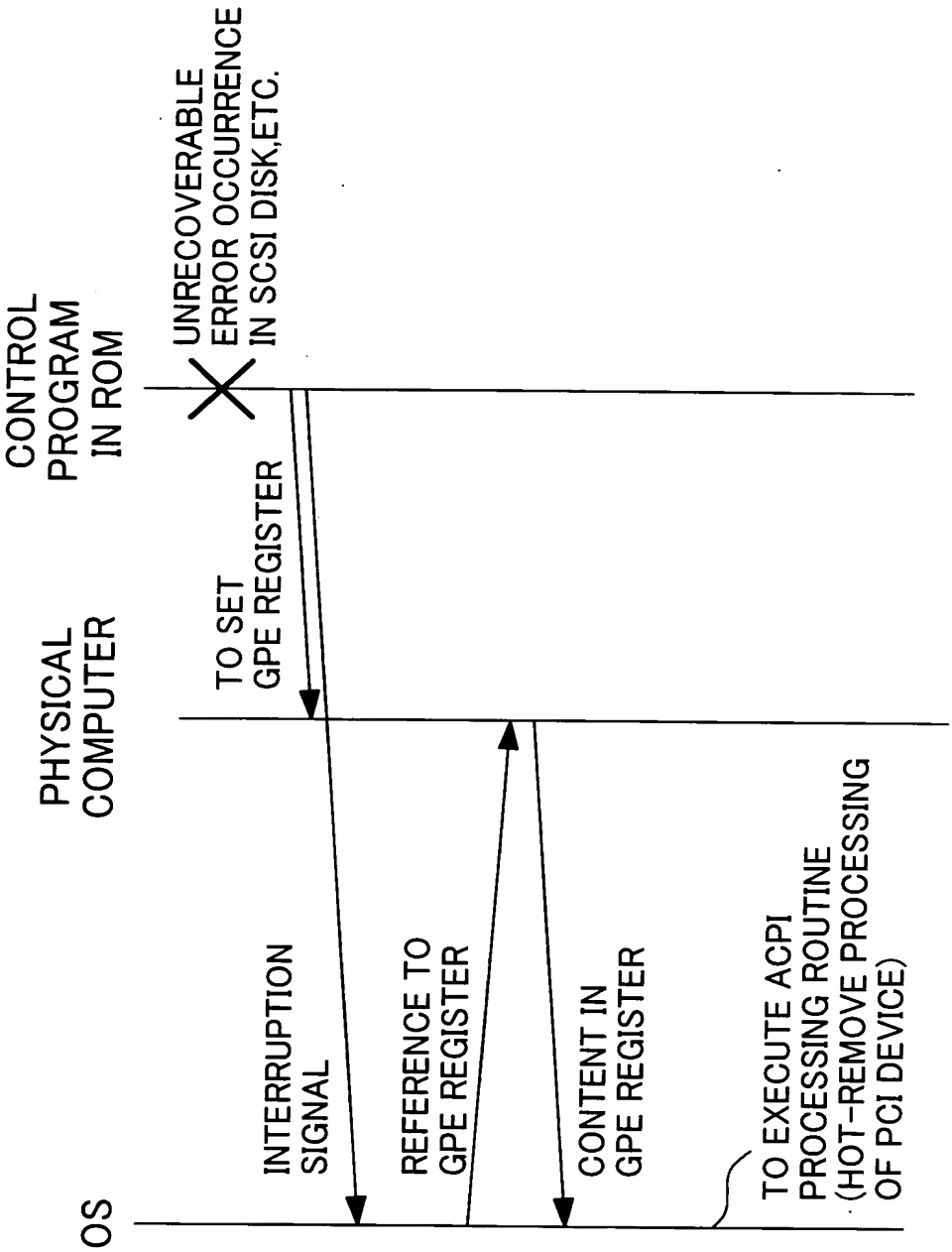

HOT ADD (HOT-REMOVE) PROCESSINGS
CONTROL PROGRAM IN ROM
PHYSICAL COMPUTER
OS
TO WRITE add_pci (rem_pci) COMMAND IN MEMORY MAPPED REGISTER
TO SET GPE REGISTER
INTERRUPTION SIGNAL
REFERENCE TO GPE REGISTER
CONTENT IN GPE REGISTER
TO EXECUTE ACPI PROCESSING ROUTINE (HOT-ADD (HOT-REMOVE) PROCESSING OF PCI DEVICE)

FIG.17

HOT-REMOVE PROCESSINGS